

Cardiovascular Wellness and Optimal Oral Health: A symbiotic Relationship

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In order to appreciate the oral/systemic connection as it relates to vascular wellness, it is important to understand health from the perspective of the arteries and the mouth. Arterial health (or cardiovascular wellness) is a state for which atherosclerosis is absent [1], and, if atherosclerosis is present in the arterial system, there is no inflammation driving further development of disease progression [2]. Optimal oral health, as it relates to vascular wellness, is an oral environment that lacks the inflammation to allow oral pathogens to invade the vascular system and create the opportunity for an unstable atherosclerotic disease state [3]. There are many conditions that cause vascular inflammation. Oral bacteria (periodontal disease) are one of those conditions.

Cardiovascular Disease: A costly condition

Cardiovascular Disease (CVD) remains the leading cause of death and disability in developed countries, creating a catastrophic financial strain on our current health care system. The current health care paradigm is structured around treating end-stage disease, treating the disease after it becomes evident. The annual expenditure allocated to treat vascular disease has skyrocketed to over 600 billion dollars, including direct and indirect costs. It is estimated to increase to 3.1 trillion dollars

annually by the year 2030 [4]. One-third of all cardiovascular deaths occur in individuals less than 75 years of age [5]. Fifty percent of annual major coronary events are recidivistic and of these, fifty percent are fatal [6].

Event Reality: What causes a cardiovascular event?

These statistics can be changed by understanding the mechanism for which heart attack and ischemic stroke occur. We can then fully appreciate the relationship between CVD and oral health. Atherosclerotic plaque silently develops in the artery wall, avoiding encroachment into the lumen resulting in an asymptomatic and potentially dangerous situation. When the artery wall weakens due to an influx of inflammation, the protective endothelial lining can rupture or erode, exposing the plaque to arterial blood flow, and subsequently creating the potential for thrombus formation. Surprisingly, the majority of these ruptures or erosions does not result in major CV events but rather create micro vascular thrombi that lead to micro vascular disease such as silent heart attacks, transient ischemic events, vascular dementia and diseases of ageing such as chronic kidney disease and peripheral arterial disease [7]. Regardless of the end result of the thrombus, the presence of an atheroma is sine qui non for a vascular event [7].

Inflammation: the keystone joining vascular and oral health

Understanding this mechanism – the inflammatory relationship between atherosclerotic plaque development and thrombus formation is the key to CVD prevention. The symbiosis between CVD and periodontal disease starts here- at the inflammatory

juncture. Periodontal Disease (PD) is one of many causes of this keystone ingredient – inflammation, both promoting the development of plaque and the unpredictable cascade of plaque rupture and thrombus formation. The American Heart Association's meta-analysis determined that CVD was greatly increased in subjects with periodontitis and subsequently confirmed an independent association between PD and CVD with Level A evidence [8]. Potentially even more concerning, oral bacteria associated with endodontic disease has been tied to actual acute coronary events [9]. Cross-sectional epidemiologic studies demonstrate the association between periodontitis and elevated risk for CVD. Specific periodontal pathogens have been shown to play a vital role in the atherogenic disease process [3]. Additionally, studies have focused on the systemic effect of periodontal intervention on surrogate indicators of CVD, including serum inflammatory markers, serum lipid levels and hemostatic factors [3].

The CORODENT study evaluated the role of periodontal pathogen burden on coronary events and PD. The controlled study of 526 patients without a known history of coronary heart disease (CHD) had sub gingival samples of biofilm analyzed for periodontal bacteria. The results reflected a statistically significant association between the periodontal pathogen burden and the presence of CHD [10]. Additionally, the INVEST trial [11], evaluated periodontal bacteria and hypertension in 653 subjects without a history of stroke or heart attack. Findings were adjusted for age, race, sex, education, BMI, smoking, DM, LDL and HDL. In subjects with the highest tertile of PD pathogen burden, systolic blood pressure was 9mmHg higher and diastolic BP was 5 mmHg higher than in subjects with the lowest tertile. Lastly, and importantly, end toxins of gram-negative bacteria, such as *Porphyromonas gingivalis* (Pg) is considered causative of periodontitis. Lipo polysaccharide end toxin (LPS), a specific toxin of this bacterium, is common to other bacterial diseases such as *E. coli* and *Salmonella* infections. Pg LPS has been shown to stimulate atherosclerotic related gene expression in foam cells and to stimulate transcription of pro-inflammatory cytokines, adhesion molecules and growth factors [10] concluding that the end

toxins of Pg are directly involved in the development of atherosclerotic vascular disease.

Who's role is it anyway?

Appreciating the relationship between the inflammatory cascades associated with oral health and CVD, a dialogue between the medical provider and the dental provider must be nurtured. A conundrum potentially exists when we find a chasm between the medical and dental models of care. This divide is deeply rooted in academia and carried into practice. Many medical providers who treat vascular disease received minimal training to know how to properly assess for oral inflammation. Additionally, the dental providers may struggle to push boundaries of care beyond the oral cavity, potentially fearing the public perception. For those practicing CVD prevention in the medical model, we celebrate dental professional involvement on the team, being so bold as to suggest that it is necessary if we want to mitigate the potentially devastating effects of CVD. Statistically, 65-70% of adults see the dentist annually whereas up to 20% of these patients have not had a medical appointment in the preceding year.

The public agrees. Adult dental patients were surveyed as to their perception of receiving medical screenings while in the dental setting and there was a 94% approval of this approach. Specifically, 90% of the patients surveyed felt it important for dental professionals to screen for hypertension and over 80% felt it valuable to be screened for diabetes and CVD in the dental setting [12]. The overwhelming (>75%) opinion was that their view of the dental provider would improve for knowledge and professionalism, competence and compassion [13]. In addition to gaining public approval, periodontal therapy also saves healthcare costs in diabetic and CVD patients. Analyzing over 100,000 PD patients with diabetes and/or CVD, mean age 48.7 ($\pm$ 10.9 years). PD treatment required $\geq$ 4 dental visits annually, mainly scaling and root planning along with flap surgeries as needed and routine cleanings. The primary outcome was all medical (non-dental) costs in years 2006-2009. The secondary outcome was yearly hospitalizations/1000 clients in

years 2005-2009. Treatment of PD resulted in a 40% decrease in annual dollars spent on stroke and diabetes. A 10% decrease in resource expenditure was utilized for CHD care. Hospitalizations were decreased on average 20-30% for CHD related issues, including diabetes, stroke and heart disease [12].

Joining hands to prevent CVD

The language spoken between the medical and dental community in regards to CVD must be one of mutual recognition. In the medical community, laboratory data is utilized to reveal hidden causes of vascular inflammation. We utilize blood and urine tests to evaluate the effectiveness of treatment, lifestyle and pharmaceutical interventions, on the endothelium and intima layers of the artery, providing confidence to know that the patient is safe. Likewise, we embrace technology to identify asymptomatic atherosclerosis and follow the disease over time. This approach, called the Bale/Doneen Method has been proven to be effective in generating a positive effect on the atherosclerotic disease process by achieving regression of disease in the carotid arteries [14]. Ultimately we are treating a disease that we hope our patients never feel. If they were to 'feel' the disease, a rupture or an erosion would have resulted in a thrombotic event. Optimal CV wellness and optimal oral health are tied together by a lack of inflammatory burden. Knowing that periodontal disease and endodontic pathogen burden are one of the critical root causes of this inflammatory disease, we rely on our dental colleagues to participate in CVD prevention. We feel it to be our responsibility to learn how to assess for gingival inflammation in the medical office and we ask our dental colleagues to participate in laboratory testing to determine pathogen burden objectively with PCR laboratory testing so that the language between providers can be objective and understood.

In addition to speaking the same laboratory language to diagnose PD and vascular inflammation, it is a solid idea to propose a care model that invites registered dental hygienists into the medical office to teach and assess patients about proper

dental hygiene is a strong starting point. Atherosclerotic vascular disease is a multi-faceted inflammatory condition that involves many specialists to properly treat. The ideal medical model welcomes our dental colleagues to a team of specialists that encompass providers in the areas of family practice, cardiology, sleep medicine, endocrinology, psychology, nutrition, exercise science and life coaching. We view inflammation driven by oral health on par with other inflammatory causative factors such as insulin resistance, sleep apnea, dyslipidemia and hypertension among others. We ask for a partnership with our dental colleagues to join in the fight against the devastating effects of cardiovascular disease. Together, we can achieve optimal wellness.

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